UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources | UC Master Gardener Program

Did you know there is a direct link between soil and climate change?

How we treat the soil in our home gardens and landscapes can either contribute to global warming or help decrease the effects of climate change. Our global temperatures are increasing due to the burning of fossil fuels, but also traditional farming and gardening practices have added greatly to the problem.

Functions of Soil Organisms

Type of Soil Organism		Major Functions
Photosynthesizers	• Plants • Algae • Bacteria	**Capture energy** • Use solar energy to fix CO_2. • Add organic matter to soil (biomass such as dead cells, plant litter, and secondary metabolites).
Decomposers	• Bacteria • Fungi	**Break down residue** • Immobilize (retain) nutrients in their biomass. • Create new organic compounds (cell constituents, waste products) that are sources of energy and nutrients for other organisms. • Produce compounds that help bind soil into aggregates. • Bind soil aggregates with fungal hyphae. • Nitrifying and denitrifying bacteria convert forms of nitrogen. • Compete with or inhibit disease-causing organisms.
Mutualists	• Bacteria • Fungi	**Enhance plant growth** • Protect plant roots from disease-causing organisms. • Some bacteria fix N_2. • Some fungi form mycorrhizal associations with roots and deliver nutrients (such as P) and water to the plant.
Pathogens **Parasites**	• Bacteria • Fungi • Nematodes • Microarthropods	**Promote disease** • Consume roots and other plant parts, causing disease. • Parasitize nematodes or insects, including disease-causing organisms.
Root-feeders	• Nematodes • Macroarthropods (e.g., cutworm, weevil larvae, & symphylans)	**Consume plant roots** • Potentially cause significant crop yield losses.
Bacterial-feeders	• Protozoa • Nematodes	**Graze** • Release plant available nitrogen (NH_4^+) and other nutrients when feeding on bacteria. • Control many root-feeding or disease-causing pests. • Stimulate and control the activity of bacterial populations.
Fungal-feeders	• Nematodes • Microarthropods	**Graze** • Release plant available nitrogen (NH_4^+) and other nutrients when feeding on fungi. • Control many root-feeding or disease-causing pests. • Stimulate and control the activity of fungal populations.
Shredders	• Earthworms • Macroarthropods	**Break down residue and enhance soil structure** • Shred plant litter as they feed on bacteria and fungi. • Provide habitat for bacteria in their guts and fecal pellets. • Enhance soil structure as they produce fecal pellets and burrow through soil.
Higher-level predators	• Nematode-feeding nematodes • Larger arthropods, mice, voles, shrews, birds, other above-ground animals	**Control populations** • Control the populations of lower trophic-level predators. • Larger organisms improve soil structure by burrowing and by passing soil through their guts. • Larger organisms carry smaller organisms long distances.

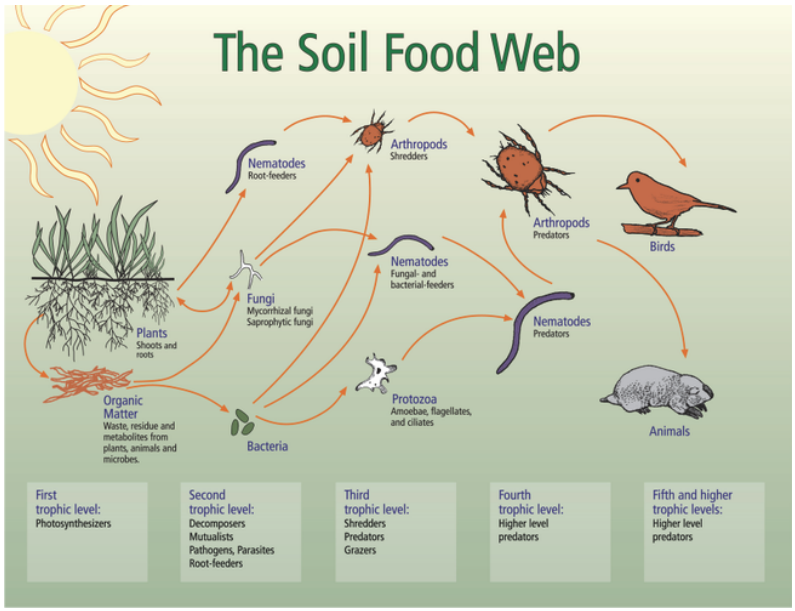
Historically, tilling the land and leaving it fallow between crops have been the normal practices, which releases carbon into the atmosphere. We have an overabundance of carbon and other

greenhouse gasses trapping heat and raising temperatures. When soil is left bare, the sun bakes it to such high temperatures that it kills the essential organisms underground that plants need to grow.

In just one teaspoon of healthy soil, there are billions of living organisms, far more than the number of people on Earth.

Healthy soil is full of living organisms and is exceptionally complex, comprising a vast community of microscopic bacteria, fungi, protozoa, and nematodes, as well as earthworms, spiders, and insects. This soil community builds carbon stores through its interactions within the soil structure of living roots and decomposing organic matter.

Home gardeners have traditionally performed similar soil preparation methods as farmers. We dug throughout the garden to break up dirt clods and loosen the soil, while at the same time we were destroying the web of living roots and organisms needed to grow healthy plants. Instead, dig a hole only the size needed to accommodate a plant, avoid compacting the soil so air and water can penetrate, and keep the ground covered to retain moisture for roots and living organisms to stay cool. The added benefit is the carbon will stay stored in the ground where it can benefit the life there.



A Soil Food Web Glossary

Arthropods	Invertebrate animals with jointed legs. They include insects, crustaceans, sowbugs, arachnids (spiders), and others.
Bacteria	Microscopic, single-celled organisms that are mostly non-photosynthetic. They include the photosynthetic cyanobacteria (formerly called blue-green algae) and actinomycetes (filamentous bacteria that give healthy soil its characteristic smell).
Fungi	Multi-celled, non-photosynthetic organisms that are neither plants nor animals. Fungal cells form long chains called hyphae and may form fruiting bodies such as mold or mushrooms to disperse spores. Some fungi, such as yeast, are single-celled. **Saprophytic fungi:** Fungi that decompose dead organic matter. **Mycorrhizal fungi:** Fungi that form associations with plant roots. These fungi get energy from the plant and help supply nutrients to the plant.
Grazers	Organisms, such as protozoa, nematodes, and microarthropods, that feed on bacteria and fungi.
Microbes	An imprecise term referring to any microscopic organism. Generally, "microbes" includes bacteria, fungi, and sometimes protozoa.
Mutualists	Two organisms living in an association that is beneficial to both, such as the association of roots with mycorrhizal fungi or with nitrogen-fixing bacteria.
Nematodes	Tiny, usually microscopic, unsegmented worms. Most live free in the soil. Some are parasites of animals or plants.
Protozoa	Tiny, single-celled animals, including amoebas, ciliates, and flagellates.
Trophic levels	Levels of the food chain. The first trophic level includes photosynthesizers that get energy from the sun. Organisms that eat photosynthesizers make up the second trophic level. Third trophic level organisms eat those in the second level, and so on. It is a simplified way of thinking about the food web. In reality, some organisms eat members of several trophic levels.

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